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158. Proposed by JOHN MACNIE, A. M., Professor of Latin, University of North Dakota.

Show by a simple diagram that:

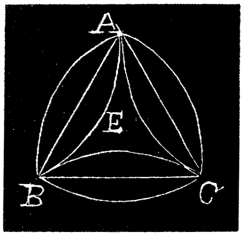
(*a*) If the angle-sum of an equilateral triangle is constant, that constant is a straight angle.

(*b*) If the angle-sum is less than a straight angle, the sum increases as the triangle grows less.

(*c*) If the angle-sum is greater than a straight angle, the sum decreases as the triangle grows less.

Solution by G. B. M. ZERR, A. M., Ph. D., Professor of Chemistry and Physics, The Temple College, Philadelphia, Pa.

(1) In the plane equilateral triangle whose sides are equal to AB, the angle sum is constant and equal to a straight angle.



(2) In the spherical equilateral triangle whose sides are equal to AEB, the angle sum is less than a straight angle and approaches a straight angle as the sides approach straight lines.

(3) In the spherical equilateral triangle whose sides are equal to ADB, the angle sum is greater than a straight angle and this sum approaches a straight angle as the sides approach straight lines. In (2) the angle sum must increase and in (3) decrease to approach a straight angle.

Also solved by the *PROPOSER*.

159. Proposed by FRANCIS W. HANNAWALT, Professor of Mathematics and Astronomy in Iowa Wesleyan University. Mt. Pleasant, Iowa.

A man desires to lay out a half-mile race course by using two circles of 150 feet radius and their internal tangents. How far apart shall the circles be placed ?

I. Solution by H. C. WHITAKER, Ph. D., Professor of Mathematics, Manual Training School, Philadelphia, Pa.

Draw the figure to the scale of 1:150. Denote the half distance between centers by x. Then one fourth of the whole path$=\sqrt{[x^2-1]}+\sec^{-1}[-x]=4.4$.

That is; $\sqrt{\{[x+1][x-1]\}}+\sec^{-1}[-x]-4.4=0$.

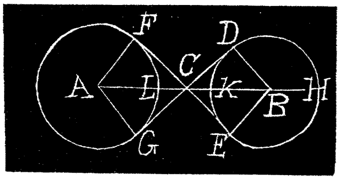
If $x=1, f(x)=-1.26$; $x=2, f(x)=-0.57$;

$x=3, f(x)=+0.34$; $x=2.63723$.

Required distance$=300x=791.169$ feet.

II. Solution by G. B. M. ZERR, A. M., Ph. D., The Temple College, Philadelphia. Pa.; and F. ANDEREGG, A. M., Oberlin College, Oberlin, O.

Let $BD=150$ feet$=r$, $\angle DBC=\theta$.



Then $CD=r\tan\theta$, $CB=r\sec\theta$, arc$DH=r(\pi-\theta)$, $LK=2r(\sec\theta-1)$.

Length of course$=4r(\pi-\theta+\tan\theta)=2640$ feet.

$\therefore\ 600(\pi-\theta+\tan\theta)=2640$.

$\pi-\theta+\tan\theta=4.4$. $\tan\theta-\theta=1.2584$.

$\therefore\ \theta=67^\circ\ 43'$ nearly. $AB=2r\sec\theta=791.16$ feet.
$LK=2r(\sec\theta-1)=491.16$ feet.

Also solved by *J. SCHEFFER*.

CALCULUS.

119. Proposed by **JOHN M. COLAW, A. M., Monterey, Va.**

Rectify the Folium of Descartes, the equation of which is $x^3+y^3+3axy=0$.

Solution by **G. B. M. ZERR, A. M., Ph. D., Professor of Chemistry and Physics, The Temple College, Philadelphia, Pa.**

Substitute $-\dfrac{1}{\sqrt{2}}(x+y)$ and $-\dfrac{1}{\sqrt{2}}(x-y)$ for x and y, respectively, (revolving the axis through 135°) and the equation becomes

$$3y^2(a\sqrt{2}+2x)=x^2(3a\sqrt{2}-2x) \text{ or } 3y^2(a+x\sqrt{2})=x^2(3a-x\sqrt{2}).$$

$$\therefore\ y=\pm\frac{x\sqrt{(3a-x\sqrt{2})}}{\sqrt{[3(a+x\sqrt{2})]}}.$$

$$\frac{dy}{dx}=\frac{3a^2-2x^2}{\sqrt{[3(a+x\sqrt{2})^3(3a-x\sqrt{2})]}}.$$

$$\frac{ds}{dx}=\frac{\sqrt{[2(9a^4+12a^3x\sqrt{2}+12a^2x^2-4x^4)]}}{(a+x\sqrt{2})\sqrt{[3(a+x\sqrt{2})(3a-x\sqrt{2})]}}.$$

Let $a-x\sqrt{2}=2a\sin\theta$.

$$\therefore\ S=-\frac{a}{\sqrt{6}}\int\frac{\sqrt{(13-20\sin\theta+16\sin^3\theta-8\sin^4\theta)}}{1-\sin\theta}d\theta.$$

For the loop, $S=\dfrac{2a}{\sqrt{6}}\displaystyle\int_{-\frac{1}{2}\pi}^{\frac{1}{6}\pi}\frac{\sqrt{(13-20\sin\theta+16\sin^3\theta-8\sin^4\theta)}}{1-\sin\theta}d\theta.$

Also solved by *ELMER SCHUYLER*.

120. Proposed by **G. B. M. ZERR, A. M., Ph. D., Professor of Chemistry and Physics, The Temple College, Philadelphia, Pa.**

The axis of a paraboloid of revolution coincides with the generating line of a cylinder; the diameter of a cylinder and the latus-rectum of the parabola are each equal to the common altitude, a. Find the surface and volume of each part into which the paraboloid is divided by the cylinder.

Solution by the PROPOSER.

$x^2+y^2=az$ is the equation to the paraboloid.
Volume of paraboloid$=v_1=\frac{1}{2}\pi a^3$.
Surface of paraboloid$=s_1=\frac{1}{6}\pi a^2(5\sqrt{5}-1)$.